

115. *O. jutlandicum*, Brid. i. p. 296.

O. phyllanthum, B. et S.

Common on trees.

Genus 10. *Encalypta*, Schreb.

116. *E. vulgaris*, Hedw.

On the Downs at Halnaker near Chichester, and on the north wall of St. Nicholas Church, Brighton, Mr. Borrer. On a wall at Storrington, and on a wall between Cocking and Midhurst.

117. *E. streptocarpa*, Hedw.

In many places on the Downs: at Newtimber; Arundel Park; Offham near Lewes; and on tiles near Hurstpierpoint: always barren.

[To be continued.]

XXVI.—On the Development of the Cirripedia.

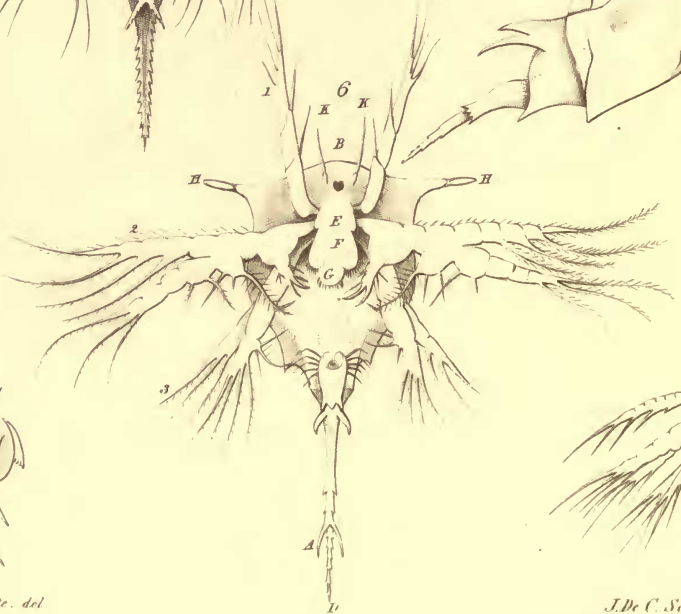
By C. SPENCE BATE.

[With three Plates.]

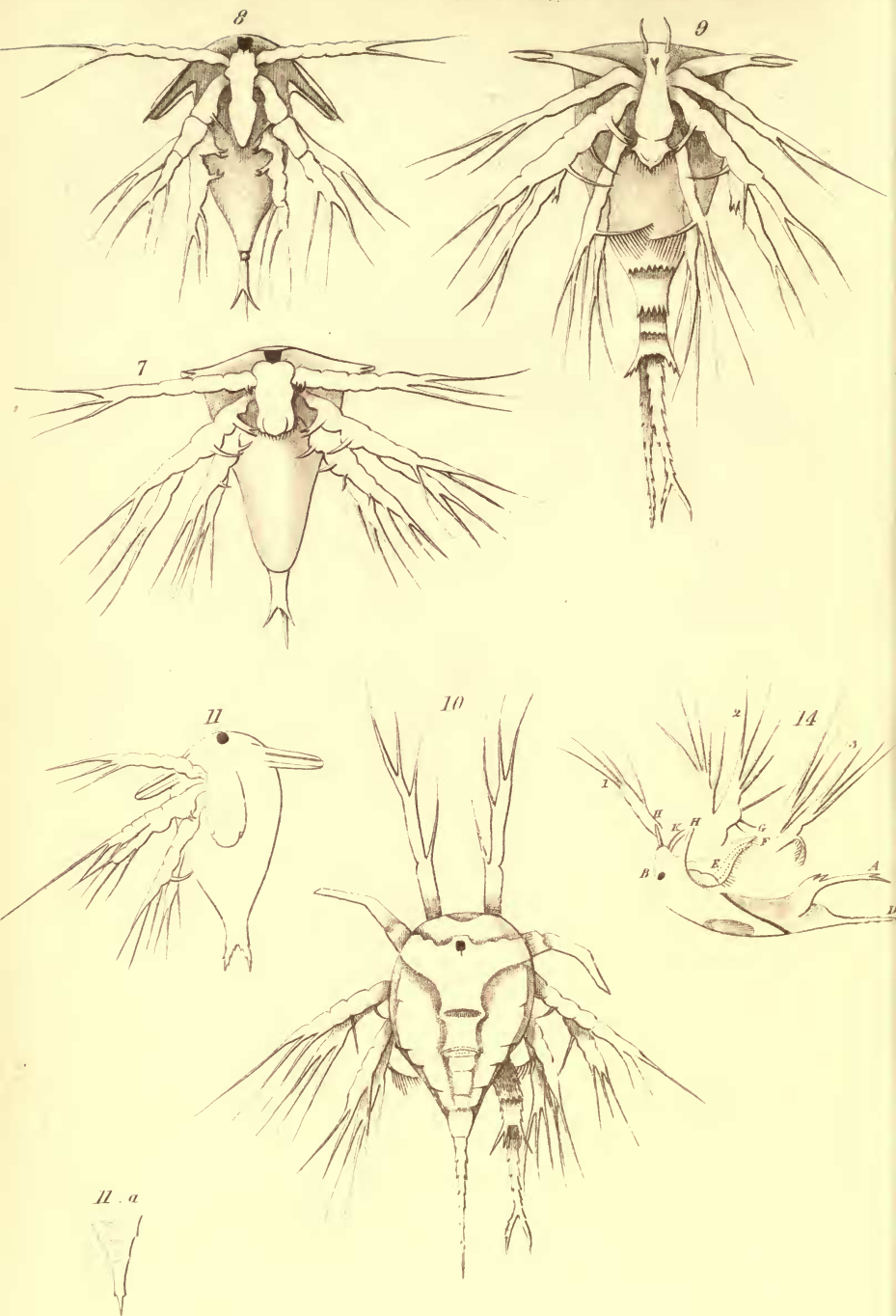
FEW animals belonging to the European fauna, so very abundant on our shores as the Cirripedia, have had their nature so misunderstood, and so long veiled in mystery. The happy discovery of Mr. J. V. Thomson, so far back as 1826, approximated somewhat to a revelation of their real history; and the later researches of Burmeister, in his Beiträge zur Naturgeschichte der Rankenfüßer, together with those of Prof. Goodsir, in the Edinburgh New Phil. Journal, July 1843, have further elucidated this interesting inquiry. Although as yet the chain of development between the ovum and the perfect animal has not been successfully observed, the hiatus is not so great but that naturalists are enabled to identify the position of these creatures in the animal kingdom.

Feeling a little curiosity in relation to the subject, and wishing to verify for myself the observations of Mr. Thomson, I took advantage of my residing near the shore where two or three distinct species are common, and have occupied myself a little this summer in endeavouring to observe the animal, as well as the changes through which the larva passes until it assumes the form and characters of the parent. Being desirous to obtain the young, so as to identify it with the species which are the parent of each, I adopted the mode of breaking off the *Balanus* from the rocks and obtaining the embryo in a mature state before it had left the ovum, and of then hatching it; which was readily accomplished upon its being plunged into sea-water,—a mode which I found

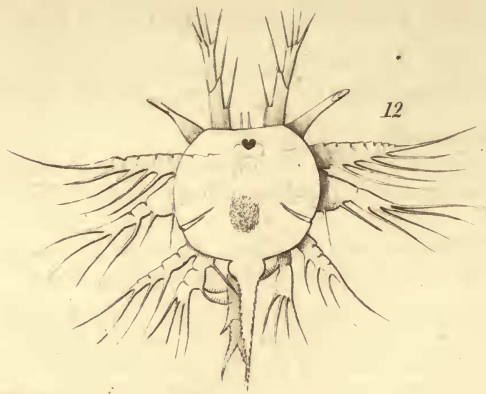




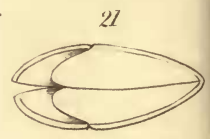








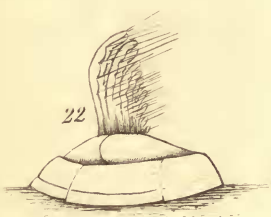
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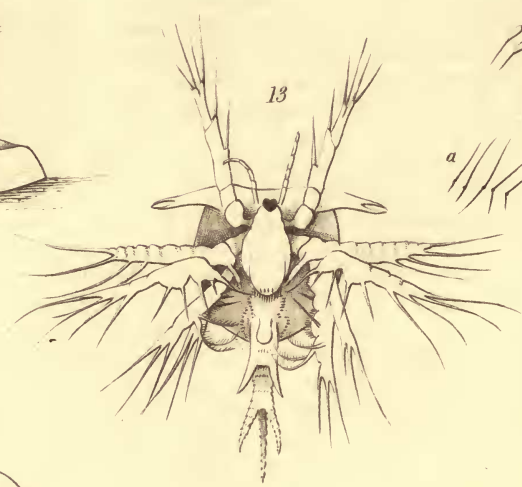
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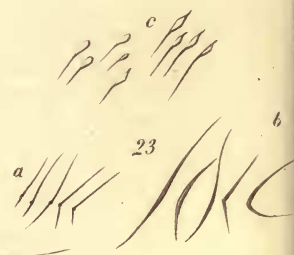
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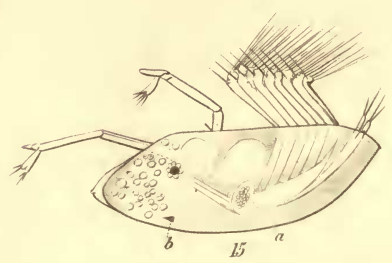
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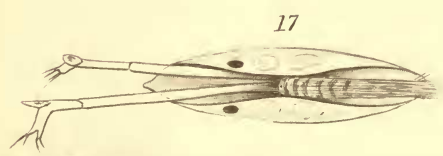
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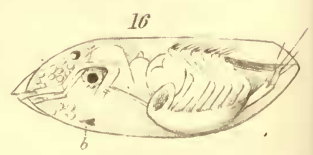
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very successful, and which has enabled me to accompany this paper with sketches of the larva of five separate species:—

1. *Balanus balanoides*, Linn.
2. *B. porcatus*, Da Costa. *B. sulcatus*, Brug. *B. Scoticus*, Wood.
3. *B. perforatus*, Brug. *B. communis*, Mont. *B.* (var.) *Cranchii*, Leach.
4. *Chthamalus depressus* (?), Poli. *Balanus punctatus*, Mont.
5. *Clitia Strömia*, Müller. *Balanus verruca*, Mont.

Upon placing the young as soon as hatched under the microscope, I was interested to find that it differed as much from Mr. Thomson's figure as that given by him does from the adult animal*, thus showing that the larva must pass through more than one metamorphosis prior to its assuming the figure of the adult.

There is, on the first appearance of the larva of the *Balani*, a single black spot in the centre of what would be termed the head of the animal, appearing like the eye in *Cyclops*, *Canthocamptus*, &c.; but this it cannot be, since the form is not persistent in every individual even of the same species. With what agency this spot may be endowed I am not capable of stating, but it appears to me to be analogous to a similar spot in the larva of *Chirocephalus diaphanus*†, and which, by development, is shown to have no connection with the eyes; so also in an older stage in the larva of the *Balanus*, the eyes, which are absent in the young, become fully developed, but are found to exist distinct from this spot, which has been looked upon as an organ of vision by all previous observers. I think, however, that we are scarcely justified in assuming every black spot in a convenient position to be an eye: and in this instance, when the spot may be seen in the young of the same parent to put on almost every modification of form, I can scarcely bring myself to subscribe to the idea of its being an agent of sight. Moreover, in the pupa state, when the eyes are large and conspicuous, there may be observed a spot (Pl. VIII. fig. 15, 16 b) upon the shell, the same which Mr. Thomson presumes to be the "nucleus of the future attachment," so like to that to which we allude in the larva, that I am inclined to believe

* When this paper was first written, I was ignorant of the discoveries of either Burmeister or Goodsir; the researches of the former I have only seen since this has been in type; and to both of whom separately is due the merit of the discovery of the great fact of the complex metamorphosis of the Cirripedia; since Mr. J. V. Thomson, although the original discoverer of both stages, did not even conjecture that there was more than a single metamorphosis, although he was aware of the fact in the marine Decapoda, attributing the earlier form or larva to the pedunculated division, and the latter or pupa to the sessile division of the Cirripedia.

† Vide figures by Dr. Baird in the 'Hist. of British Entomostraca.'

them, particularly if the homologies as pointed out by Burmeister be correct, to be identical; an idea which receives support from the gradual receding of the spot from the anterior edge, near which it may be observed in the larva previous to the first moult; whereas in the next it is further back, and in the third, as given in Pl. VI. fig. 3 *b*, the only specimen of which I have had an opportunity of observing, it has considerably receded, being in a line with the extremity of the probosciform organ. Therefore, presuming such to be the case, I can scarcely appreciate the idea advanced by this latter author, that the two large eyes in the pupa are formed by the splitting into halves of this central spot; or, to translate his own words, "that the single eye is compounded of two halves, which, by degrees, separate more and more until in the following period they are divided by a considerable space."

In this description their development is not analogous to that of the eyes in the larva of the Entomostraca, which certainly in this stage must be considered as its nearest ally. For instance, in the larva of *Chirocephalus diaphanus* the two lateral organs of vision are apparent previous to the disappearance of the "central eye," plainly showing that the real eyes are not developed from the central spot, whatever it may be.

Among the more peculiar features of the larvæ of these animals is the presence of an elongated forked process of the abdomen, forming to all outward appearance a second caudal appendage, and which has been confounded with the tail in Prof. Goodsir's figure and description of the larva previous to the first moult, where he says, "the last segment is armed with three sharp strong spines which project backwards." After the first moult this appendage increases in length, greater or less in different species, by the addition of another ring proceeding from the extremity of the last, and like it terminating in a similarly forked extremity. Of its uses in the larva, or its homology in the adult animal, I have not been able to satisfy myself; but it is a feature in a more or less modified form (as far as I have observed) universally present in this early stage of their development.

In *Balanus perforatus*, *Clitia Strömia*, and *Chthamalus depressus*, the growth of the caudal appendages increases at the first moult to a length much greater in proportion than the same organs do in *Balanus balanoides*.

Another organ equally constant and peculiar to the early larval stage of these animals is, that which for convenience of communication I shall call a proboscis. This, the animal has the power of raising and lowering at pleasure, as its uses may require. At its extremity appears to be an oral-like aperture which is closed by a valve or upper lip. This organ, as far as my knowledge goes, has no analogous representation among Crustacea, it